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ScienceDirect

Procedia Environmental Sciences 29 (2015) 190 – 191

Procedia Environmental Sciences

Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)

Projected impact of future climate on drought patterns in complex rainfed environments

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Abstract

Understanding how climate change is likely to affect crop productivity is essential for global food security. Climate change studies predict an increase in rainfall variability in future decades, which is likely to affect crops grown in water-limited environments. Crop productivity results from complex interactions between genotype, management practices, and the local environment, making it challenging to characterize the crop-level impacts of climate projections. Given the importance of this task for long-term strategies in breeding, farming and policies, and the impracticality of performing sufficient relevant experiments, modeling tools are used to forecast climatic effects.

In this study, we used the APSIM-Wheat model (Holzworth et al. 2014) to identify water-stress environment types for 60 representative locations (22 regions) across the Australian wheatbelt (Chenu et al. 2013). Simulations were performed using historical climate records and for a selection of future climate scenarios provided by the Coupled Model Intercomparison Project Phase 5 (CMIP5).

Model results indicate substantial changes in water-stressed environments in the coming decades, with projected changes in drought frequency found to be highly region-specific. Regional variations were also dependent on the climate model considered, highlighting a high range of uncertainty for the future projections. In the worst-case climate scenario studied, significant increases in drought conditions, fewer planting opportunities and higher rates of unviable crops were found.

By accounting for the complex interactions between crop development and projected future climates, this study provides valuable information on the likely importance of future drought for the wheat industry. These results highlight the urgency for breeding drought-tolerant lines to secure crop productivity in rainfed regions such as Australia.

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Peer-review under responsibility of the organizing committee of the Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)
doi:10.1016/j.proenv.2015.07.255

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Keywords: crop model; APSIM; climate change; drought; water deficit; wheat

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